

Tennessee Technological University
Department of Electrical and Computer Engineering
ECE 4020/5020: Digital Signal Processing
Spring 2026

Instructor:

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Office hours: Tu 2:30 PM – 4:00 PM, W 2:30 PM – 4:00 PM, or by appointment

Textbook: J. G. Proakis and D. G. Manolakis, Digital Signal Processing – Principles, Algorithms, and Applications, 5th Edition, Pearson, 2021

Time and Place: Tu and Th, 12:00 PM – 1:15 PM, AIEB 361

Course Description:

Welcome to ECE 4020/5020: Digital Signal Processing. Advances in digital hardware such as computers and chips have made digital processing systems ubiquitous in our highly technological environment. Such systems are capable of performing complex signal processing tasks more reliably, flexibly, precisely, and less expensively compared to their analog counterparts. Digital signal processing (DSP) systems are the enabling technology for numerous innovations including smart phones, medical equipment, aerospace, communication, and robotics applications and yet they are often hidden to the end user. ECE 4020/5020: Digital Signal Processing is an introductory course that introduces the fundamental concepts and tools used in the analysis and design of most commonly employed DSP systems. While the subject has solid mathematical foundations (signals and systems theory), the objective of this course is to equip the students with the ability to analyze and relate to many real-world DSP applications.

Topics Covered:

1. Foundational concepts in discrete-time signals and systems: signals classifications, building blocks of DSP systems, periodicity, sampling, real-world examples, etc.
2. Representations and analysis of discrete-time systems: linearity, causality, block diagram representations, difference equations, impulse responses, z-transform and applications, etc.
3. Frequency domain analysis of discrete-time signals and systems: Fourier series, Fourier transforms, frequency-domain and time-domain properties, key results, frequency response, analysis of frequency selective filters, etc.
4. Processing continuous-time signals as discrete: sampling, aliasing, quantization, A/D and D/A conversion techniques, oversampling, etc.
5. Frequency domain sampling: Discrete Fourier transform (DFT), properties, FFT algorithm for DFT, computational aspects, etc.
6. Digital filter design: IIR and FIR structures, realizations, design techniques, conversion from analog designs (bilinear transformation), filtering applications, etc.

7. DSP implementation aspects: MATLAB implementation, DSP architectures, software/programming techniques, etc.

Primary Teaching Method:

Classroom lectures

Homework:

Homework will be assigned frequently. Please make sure that your writing is neat and clear, and that you have expressed your reasoning, not just the final answers. Homework will be due in class.

Grading:

ECE 4020: Homework (20%), Quizzes (10%), 3 Tests (45%), Final Exam (25%)

ECE 5020: Homework (20%), Quizzes (5%), 3 Tests (35%), Final Exam (20%), Final Project (20%)

Course Objectives:

1. Analyze discrete-time signals and systems with Fourier and z-transforms
2. Learn sampling, reconstruction, A/D and D/A converters techniques that form DSP systems
3. Design digital FIR and IIR filters for various signal processing applications
4. Gain understanding of realization, programming, and computation features of DSP algorithms
5. MATLAB implementation and architectural aspects of DSP processors

Attendance Policy:

Attendance will be observed. Students are expected to attend the lectures and are responsible for the topics covered in class.

Student Academic Integrity Policy:

Maintaining high standards of academic integrity in every class is critical to the reputation of Tennessee Tech, its students, faculty, alumni, and the employers of Tennessee Tech graduates. Academic integrity is at the foundation of the educational process and the key to student success. Students with academic integrity are committed to honesty, ethical behavior, and avoiding violations of academic integrity. All students are required to read and understand Policy 216: Student Academic Integrity. Please see the Academic Integrity website (<https://www.tntech.edu/provost/academicintegrity/>) for more information.

Instructional and Assignment Use of Artificial Intelligence:

AI is not permitted for any use within this course. For details, see the policy details on <https://www.tntech.edu/citl/ai-syllabus-statements.php>

Disability Accommodation:

Students with a disability requiring accommodations should contact the accessible education center (AEC). An accommodation request (AR) should be completed as soon as possible, preferably by the end of the first week of the course. The AEC is located in the Roaden University Center, room 112; phone 931-372-6119. For details, view Tennessee Tech's policy 340 – services for students with disabilities at policy central.

Communication Policy:

The use of communication or recording/playback devices, with the exception of devices explicitly permitted by the course instructor, is prohibited during tests and examinations. This includes, but is not limited to, cell phones, PDAs, iPods and MP3 players, tablets, computers, cameras, and headphones or in-ear earphones. All such devices must be turned off and put away in an inaccessible location such as a backpack. Accessing a prohibited device will result in the immediate termination of the quiz or examination and may result in a charge of academic misconduct.

Additional Resources

Technical Help:

If you are experiencing technical problems, visit the [myTech IT Helpdesk](#) for assistance.

If you are having trouble with one of the instructional technologies (i.e. Zoom, Teams, Qualtrics, Respondus, or any technology listed [here](#))visit the [Center for Innovation in Teaching and Learning](#) (CITL) website or call 931-372-3675 for assistance.

Tutoring:

The university provides free tutoring to all Tennessee Tech students through the Learning Center within the Volpe Library. Tutoring is available for any class or subject, as well as writing, test prep, study skills, and resume support. Appointments are scheduled, so contact the [Learning Center website](#) for more information.

Counseling and Health Services:

Tennessee Tech offers support for student well-being through two key services. The Center for Counseling and Mental Health Wellness provides brief, solution-focused therapy to help students navigate personal and social challenges. Health Services delivers accessible, high-quality, and affordable medical care to promote overall wellness. Visit their respective websites to learn more or schedule an appointment.

Emergency Preparedness Protocols:

Each student must take personal responsibility for following any University protocol related to pandemics, natural disasters, and other public health and safety events. Students are expected to follow all directives published by Tennessee Tech on its [Environmental Health & Safety webpage](#).